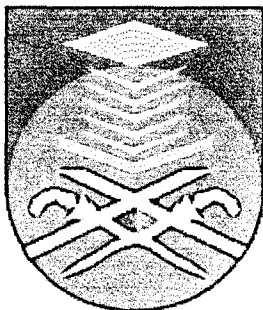


**HARDWARE DESIGN OF CONVOLUTIONAL ENCODER AND
DECODER FOR DIGITAL COMMUNICATION SYSTEM**

**Project report is presented in partial fulfillment for the reward of the Bachelor of
Electrical Engineering (Honours) (Communication)
of
UNIVERSITI TEKNOLOGI MARA**



**SAYED AZIZ BIN SAYED HUSSIN
Faculty of electrical engineering
UNIVERSITI TEKNOLOGI MARA
40 450 SHAH ALAM, SELANGOR**

ACKNOWLEDGEMENT

In the name of Allah SWT, the beneficent, the Merciful Foremost, all praise to Allah for all the incredible gift endowed upon me and for giving the health and strength to proceed the study and enable me to prepare this thesis.

I would like to take this opportunity to thank everyone who has contributed either directly or indirectly throughout this thesis and project, my family especially my loving parents, for their understanding, support and encouragement in completing this thesis.

Specifically my thank goes to my supervisor Mr. Ir Muhammad Bin Ibrahim for his guidance, support, concern and opinions throughout this thesis. Without his cooperation, support and guidance, this project may not succeed.

I'm also indebted to Mr. Kamaruzaman B. Md. Nor, Mr. Azman B. Misroo as an instructor of Communication Lab, Mr. Zamnihar as an instructor of Digital Lab for their support in hardware design and the idea, my colleagues in the faculty and to all my loving friends especially Mohd. Heary B. Mohd. Yassin and Zurina Bt. Mohamed for their cooperation and suggestion toward completing this project.

“May god bless and reward them for their generosity”

ABSTRACT

This paper focused on Convolutional Codes as one of the error detection and correction technique that use special generator polynomial. The first generator polynomial is $X^3 + X^2 + X + 1$ (1111) and the second generator polynomial is $X^3 + X^2 + 1$ (1011).

The simulation is performing using Circuit Maker for the Clock Pulse Generator to make sure the pulse is available of the D-type Flip Flop to operate. This process also is done to make sure that the pulse that we got is the suitable pulse, which is not too fast and also not too slow.

The simulation process for the encoder and decoder of this hardware is perform using XILINX Designer version 2.1 toolbox to determine the process and technique of creating a digital circuit and demonstrates how the design work in encoder and decoder.

This project is base on Convolution Codes including the theory, simulation technique and the hardware development of Convolutional Codes.

TABLE OF CONTENT

| | |
|-----------------------|------|
| DECLARATION | i |
| ACKNOWLEDGEMENT | ii |
| ABSRTRACT | iii |
| TABLE OF CONTENT | iv |
| LIST OF FIGURE | viii |
| LIST OF TABLE | ix |
| LIST OF ABBREVIATIONS | xi |

| CHAPTER | PAGE |
|---------------------------------------------|------|
| 1. INTRODUCTION | |
| 1.1 Introduction | 1 |
| 1.2 Scope of thesis | 2 |
| 1.3 Claude Shannon and Communication Theory | 2 |
| 1.4 Digital Communication System | 3 |
| 1.5 Data Communication System | 4 |
| 1.6 Advantages of Digital Communication | 5 |
| 1.7 Scope of Work | 7 |
| 2. ERROR CONTROL IN COMMUNICATION | |
| 2.1 Introduction | 8 |
| 2.2 Error Control | 10 |
| 2.3 Error Control Coding | 11 |
| 2.4 The Important of Error Coding | 12 |
| 2.5 Errol Control Code | 13 |
| 2.5.1 Convolutional Code | 13 |

| | |
|--------------------------------------------------------------------|----|
| 2.5.2 Cyclic Redundancy Check(CRC) | 14 |
| 2.5.3 Binary Linear Block Codes | 15 |
| 2.3.1 Turbo Codes | 16 |
| 2.6 Types of Error Control | 17 |
| 2.6.1 Forward Error Control | 18 |
| 2.6.2 Feedback error Control | 18 |
| 2.7 Requirement | 18 |
| 2.8 Factor Influence to the Selection of Error Detection Technique | 19 |
| 2.8.1 Bit Error Rate (BER) | 19 |
| 2..9 Type of Error | 20 |
| 2.9.1 Random Error | 21 |
| 2.9.2 Burst Error | 22 |
| 2.9.3 Systematic Error | 23 |
| | |
| 3. CONVOLUTIONAL CODES OPERATION | |
| | |
| 3.1 Introduction | 24 |
| 3.2 Advantage and Disadvantage of Convolution Code | 24 |
| 3.2.1 Advantage | 24 |
| 3.2.2 Disadvantage | 25 |
| 3.3 Application of Convolutional Code | 25 |
| 3.3 Operation of Convolutional Code | 26 |
| 3.4.1 Tree Diagram | 28 |
| 3.4.2 Trellis Diagram | 30 |
| 3.4.3 State Diagram | 32 |
| 3.4.5 Decoding | 33 |
| 3.5 Channel Model | 36 |
| 3.5.1 Binary Symmetric Channel | 36 |
| 3.5.2 Gaussian Channel | 39 |